PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of

Applicant	:	Robert J. Crist
Serial No.	:	10/802,104
Filed	:	March 16, 2004
Title	:	SINGLE INERTIA BENDING DAMPER
Docket	:	02-10
Tech. Center	:	3600
Art Unit	:	3682
Office :		Luong, Vinh

Appeal Brief filed via EFS-Web

Sir:

APPEAL BRIEF

This is an appeal from the Final Rejection mailed March 7, 2007. A Notice of Appeal was submitted on June 5, 2007.

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I. Real Party in Interest

This application is assigned to Dayco Products, LLC, as evidenced by the Assignment recorded on March 16, 2004 at Reel/Frame 015102/0700. Accordingly, Dayco Products, LLC is the real party in interest.

II. Related Appeals and Interferences

This application is not related to any appeals or interferences known to applicant.

III. Status of Claims

Claims 1-9, 11, and 24 are pending in the application.

Claims 10, and 12-23 were previously canceled.

The appealed claims are claims 1-11, and 24.

IV. Status of Amendments

The Supplemental Amendment filed January 8, 2007 has been entered.

An Amendment Under 37 CFR 41.33 to amend the specification and figures, filed July 25, 2007, has not been entered.

V. Summary of the Claimed Subject Matter

(A) Claim 1

Claim 1 is directed to a vibration damper (24) for torsional and bending vibrations in a rotating shaft having an axis of rotation. *See* FIG. 1. The vibration damper includes a hub (32) adapted to be coupled to a shaft for rotational movement (Application page 5, ¶ [0022]), an inertia element (34) concentric with the hub (32) (page 6, ¶ [0025]), and an elastic element (36) adapted to non-rigidly couple the hub (32) and the inertia element (34) (page 6, ¶ [0026]). *See* FIG. 2. The elastic element (34) possesses a first shear modulus in a first direction and a second shear modulus in the second direction (page 6, ¶¶ [0025], [0029]-[0032]; *see* FIGS. 4-5). The first shear modulus and the second shear modulus are different (page 7-8, ¶¶ [0031]-[0033]).

(B) Claim 24

Claim 24 is directed to another embodiment of a vibration damper (24) for torsional and bending vibrations in a rotating shaft having an axis of rotation. *See* FIG. 1. The vibration damper includes a hub (32) adapted to be coupled to a shaft for rotational movement (Application page 5, ¶ [0022]), an inertia element (34) concentric with the hub (32) (page 6, ¶ [0025]), and an anisotropic elastic element (36) adapted to non-rigidly couple the hub (32) and the inertia element (34) (page 6, ¶¶ [0026], [0031]). *See* FIG. 2. The anisotropic elastic element has a first shear modulus in a first direction and a second shear modulus in a second direction that is different from the first shear modulus (page 6-8, ¶¶ [0025], [0029]-[0033]).

VI. Grounds of Rejection to Be Reviewed on Appeal

The Grounds of Rejection are:

(1) Claims 1-9, 11, and 24 stand rejected under 35 USC §103(a) as being obvious in light of Haga et al. (USPN 6,345,430) in view of Harris' Shock and Vibration Handbook.

VII. Argument

I. Objections to the Drawings

Applicant submitted an Amendment Under 37 CFR 41.33 to amend the specification and Figures 2, and 4-6 to comply with the Office's objections to the Drawings. The Drawings once accepted eliminate an issue for appeal. The fill patterns for the fiber orientations were amended so that they no longer resemble refractory material, synthetic sponge, or sand. The specification was amended to refer to Figures 6A-6C instead of Detail C Option 1, Detail C Option 2, and Detail D. No new matter was added to the figures.

II. 35 USC §103(a) Rejections

Claims 1-9, 11, and 24 stand rejected under 35 USC §103(a) as being obvious in light of U.S. Patent No. 6,345,430 ("Haga") in view of Harris' Shock and Vibration Handbook. Applicant respectfully submits that the rejection should be reversed by the Board as based upon impermissible hindsight guided by the Applicant's own invention.

As set out clearly in the Background section of the application as filed, the crankshaft of an automobile experiences torsional vibrations as the crankshaft is rotated by the engine as well as bending vibrations at the crankshaft's nose. Crankshaft dampers are used to alter these vibrations. Typical dampers include an inertial mass coupled to the crankshaft by an elastic element that possesses a torsional spring rate. A single inertia damper that can control both the torsional vibrations and the bending vibrations is more cost effective and efficient for the automobile than having separate dampers control the different types of vibrations.

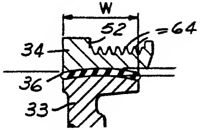
It is desirable within a single inertia damper to control the torsional vibrations and the bending vibrations independent of one another. However, most materials have a spring rate/shear rate that is the same in the torsional direction and the axial direction, so that the torsional frequency of the damper cannot be altered independently of the bending frequency. The prior art such as USPN 5,231,893, as explained on page 2 of the application, found that by altering the joint geometry of the crankshaft-to-inertial mass joint the torsional spring rate may be governed by the shear rate of the elastic element while the bending spring rate may be governed by the modulus of compression of the elastic element and that altering the geometry

permits independent adjustment of the torsional and bending frequencies. The manufacturing of the joint geometry is costly and time consuming, and such costs increase each time subsequent redesign of the joint geometry is needed as the frequencies change during operation of the engine.

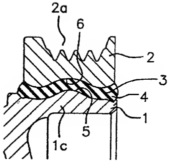
Applicant has achieved a better design for a single bending damper. Independent claim 1 is directed to a vibration damper for damping torsional and bending vibrations in a rotating shaft that recites an "elastic element [that] possesses a first shear modulus in a first direction and a second shear modulus in a second direction and wherein the first shear modulus and the second shear modulus are different." Independent claim 24 is directed to a vibration damper for damping torsional and bending vibrations in a rotating shaft that recites an "anisotropic elastic element having a first shear modulus in a first direction and a second shear modulus in a second direction that is different from the first shear modulus." Applicant's elastic member provides independent control of the torsional and bending vibrations. A damper having the claimed elastic member is cheaper and easier to manufacture than the altered joint geometry. Additionally, it is more cost-effective and easy to replace the elastic element when the damper needs adjustments.

The Office admits that the primary reference, Haga, does not teach an elastic element having different first and second shear modulus in a first and second direction. (Final Office Action, pg. 4). The Office concludes, however, that it would have been obvious to one of ordinary skill in the relevant art to "select the well known elastic material that possesses first and second shear modulus in first and second directions in order to dampen the shock and vibration in Haga's damper as taught or suggest[ed] by Harris." (Final Office Action, pg. 4-5). Applicant respectfully contends that the Office's conclusion is incorrect.

The Haga reference teaches a damper that is essentially the same as the vibration dampers in the prior art, like USPN 5,231,893, discussed in the Background section of the application. Both Haga and the '893 patent, as shown in the side-by-side figures below, rely upon the geometry of the interface between the hub and the inertia element (i.e., the joint geometry) to dampen vibrations occuring in the torsional and axial directions.



The '893 patent Fig. 3



Haga et al. Fig. 1

Note the even more extreme joint geometry in Haga's Fig. 1. The joint geometries shown in the figures take advantage of the difference between the spring rate of the elastic element in shear and the spring rate of the elastic element in compression. The altered joint geometry changes how the hub and inertia element compress the elastic element, and as such uses the modulus of compression for the elastic element to adjust the bending frequency of the damper. Also, the altered joint geometry changes how the hub and inertia element slide rotationally with respect to one another as the hub and inertia element rotate with the crankshaft and as such uses the torsional spring rate for the elastic element to adjust the torsional frequency of the damper.

Applicant admits that vibration dampers having a hub and inertia element with altered joint geometries, and an elastic element for rotating shafts are known. In fact, Applicant specifically distinguished them from the claimed damper in the Background section of the application. Applicant further admits that anisotropic materials are known that possess different properties, including different shear moduli, in different directions.

Applicant's invention lies in the identification of the various shortcomings of the existing geometry-driven dampers, i.e., Haga and the '893 patent, and the realization that the special properties of anisotropic elastic materials are well suited to resolve the particular problems associated with vibrations in rotating shafts.

The Office's obviousness determination is nothing more than a bare conclusion that since vibration dampers for rotating shafts are known and because anisotropic elastic materials are known, it would have been obvious to use anisotropic elastic materials in existing vibration dampers. The Office's conclusion is simply incorrect.

Applicant submits that the Office used impermissible hindsight in the obviousness rejection. The reason for combining the cited references cannot come from the patent application itself. MPEP § 2143. Haga does not mention composites, yet the Office picked a handbook regarding composites to combine with Haga for an obviousness rejection. It is applicant's specification that suggests a fiber-filled composite in place of a traditional elastic element. It is applicant's discussion of composites that led the Office to look for the Harris reference regarding composites. This type of hindsight analysis is improper. Accordingly, the final rejection should be reversed.

A *prima facie* case of obviousness should be based on some suggestion or motivation to modify or combine the references. MPEP § 2143. Here, there is no suggestion or motivation to alter the elastic element of Haga. Haga merely lists a few rubber-like elastic materials, yet the Office cites col. 3, lines 34-45 of Haga as teaching an elastic element that comprises a composite material. Applicant disagrees. Haga states that "[t]he elastic body 4 is annularly formed from a given rubber-like elastic material (vulcanized rubber)." Vulcanized rubber is not a composite. Haga never mentions the use of fiber-filled composites, so there is no reason, in light of Haga, that a person of ordinary skill in the art would look to Harris' Handbook chapter on composites. Accordingly, the final rejection should be reversed because there is no prima facie case of obviousness.

Furthermore, if Applicant's anisotropic elastic element were placed into Haga's damper, which includes an altered joint geometry, a new problem would arise in that the curved joint geometry would need to be altered, if not removed. Haga has no teaching regarding removing or reducing the joint geometry. The combination of references as suggested by the Office simply has no reasonable expectation of success and in fact would require substantial modification of the Haga reference. Accordingly, the final rejection should be reversed.

Additionally, Applicant notes that Harris does not teach, as the Office contends, an <u>elastic element</u> having "a first shear modulus in a first direction and a second shear modulus in a second direction and wherein the first shear modulus and the second shear modulus are different." With respect to the Office's arguments on pages 8 and 9 of the Final Office Action, only two of the <u>fibers</u> listed in Table 35.5 have anisotropic properties, and there is no teaching regarding embedding those fibers in an <u>elastic element</u>. Harris does not discuss <u>elastic</u> polymer matrix

composites, but only discusses resin polymer matrix composites, such as an epoxy. *See* Harris Tables 35.2 and 35.6. Additionally, Applicant notes that the majority of Chapter 35 focuses on laminate composites including FIGS. 35.4-35.6, which the Office referenced. *See* Harris pages 35.3-35.4, 35.6-35.7, and 35.8-35.30. The Office also refers applicant to pages 35.12-35.18 of Harris' Handbook, which are part of the Laminated Composite Design section. One of skill in the art would not be motivated to combine Haga and Harris to achieve an elastic element having different first and second shear modulus in a first and second direction because neither reference teaches such an elastic element.

Additionally on page 8, the Office argued, with regards to the "axial elastic modulus" and the "transverse elastic modulus" of Table 35.5, that since the listed fibers' elastic modulus are "different in axial and transverse directions[; t]herefore, the shear modulus of the listed fibers in axial and transverse directions are different because the shear modulus is proportional to the elastic modulus." Applicant's claims 1 and 24 are not directed to fibers, but are directed to an "elastic element [that] possesses a first shear modulus in a first direction and a second shear modulus in a second direction and wherein the first shear modulus and the second shear modulus are different."

Also on page 8, the Office cites to *Wikipedia* as support for the shear modulus being proportional to the elastic modulus (Young's modulus). Applicant notes that the equation on *Wikipedia*'s Shear modulus page that relates the shear modulus, Young's modulus, and Poisson's ration is for isotropic materials, not anisotropic materials.

CONCLUSION

As argued above, the Final Rejection should be reversed. The Office has not shown a proper motivation or suggestion to combine the references, no reasonable expectation of success, and/or that all the claim limitations are met. Additionally, the Office used impermissible hindsight in the combination of Haga and the Harris' Handbook. Accordingly, the Applicant respectfully requests that the Board reverse the Office's rejections of claims 1-9, 11, and 24 and remand the application with directions to issue an allowance.

Respectfully submitted,

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VIII. Claims Appendix

1. A vibration damper for damping torsional and bending vibrations in a rotating shaft having an axis of rotation, the vibration damper comprising:

a hub adapted to be coupled to the shaft for rotational movement therewith;

an inertia element concentric with the hub; and

an elastic element adapted to non-rigidly couple the hub and the inertia element;

wherein the elastic element possesses a first shear modulus in a first direction and a second shear modulus in a second direction and wherein the first shear modulus and the second shear modulus are different.

2. The vibration damper of claim 1 wherein the elastic element comprises a composite material.

3. The vibration damper of claim 2 wherein the composite material comprises an elastomer having a plurality of fibers dispersed therein.

4. The vibration damper of claim 3 wherein the plurality of fibers are dispersed within the elastomer in a unidirectional orientation.

5. The vibration damper of claim 3 wherein the plurality of fibers are dispersed within the elastomer in a longitudinal orientation with respect to the elastic element.

6. The vibration damper of claim 3 wherein the plurality of fibers are dispersed within the elastomer in an axial orientation that is substantially parallel to the axis of rotation.

7. The vibration damper of claim 3 wherein the plurality of fibers are dispersed within the elastomer in a radial orientation with respect to the axis of rotation.

8. The vibration damper of claim 1 wherein a first surface located on the inertia element is spaced radially outwardly from a second surface located on the hub, and wherein the elastic element is located between the first surface and the second surface.

9. The vibration damper of claim 1 wherein an outer surface of the inertia element is adapted to receive a power-transmitting belt.

10. Cancelled

11. The vibration damper of claim 1 wherein an outer surface of the hub is adapted to receive a power-transmitting belt.

12. – 23. Cancelled

24. A vibration damper for damping torsional and bending vibrations in a rotating shaft having an axis of rotation, the vibration damper comprising:

a hub adapted to be coupled to the shaft for rotational movement therewith;

an inertia element concentric with the hub; and

an anisotropic elastic element adapted to non-rigidly couple the hub and the inertia element, the anisotropic elastic element having a first shear modulus in a first direction and a second shear modulus in a second direction that is different from the first shear modulus.

IX. Evidence Appendix

None.

X. Related Proceedings Appendix

None.